

HQ U.S. Air Force Academy

Integrity - Service - Excellence

Practical Application of Principle-Agent and Auction Theory: A Contracting Guide



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Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE MAY 2015		2. REPORT TYPE		3. DATES COVERED 00-00-2015 to 00-00-2015	
4. TITLE AND SUBTITLE Practical Application of Principle-Agent and Auction Theory: A Contracting Guide				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) HQ U.S. Air Force Academy, Colorado Springs, CO				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Presented at the 12th Annual Acquisition Research Symposium held May 13-14, 2015 in Monterey, CA.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 22	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			



Overview

- **Overview of Environment**
- **Potential Improvements**
 - Risk Sharing (contract type selection)
 - Second Price Sealed Bid
 - Second Score Sealed Bid
- **USAF T-X Program**
- **Contractor Reputation Rating**
- **Summary**



Introduction

■ Statement of the Problem

- The DOD holds an inferior position when bargaining with the private sector (known budget). This creates inefficiencies in procurement leading to excess spending for the quality of product supplied.

■ Research Questions

- What mechanisms should the DOD employ to incentivize truth telling and efficiency in performance?





Risk Sharing

- **Why discuss principle-agent (government-contractor) risk sharing?**
 - **Tendency to inappropriately skew towards risk sharing extremes (FFP₁ and TM₂)**
 - FFP₁
 - TM₂
 - **The DOD is missing out on the full breadth of tools currently offered.**

¹USD (AT&L) Kendall, Frank. Use of Fixed-Price Incentive Firm (FPIF) Contracts in Development and Production. Defense AT&L, Mar-Apr 2013.

²USD (AT&L) Kendall, Frank. Appropriate Use of Lowest Priced Technically Acceptable Source Selection Process and Associated Contract Type. 4 March 2015.



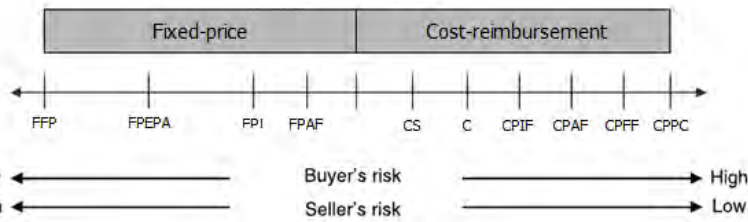
Risk Sharing

Types of Contracts



Types of Contracts by Risk₃

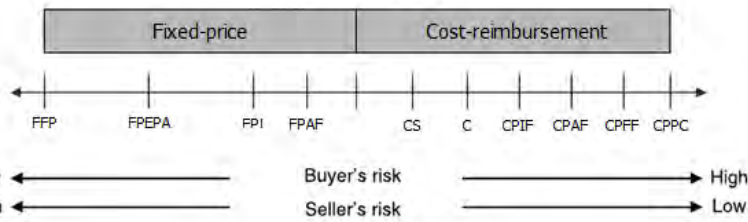
₃Adapted from Garrett, 2007, World class contracting (4th ed.)



Risk Sharing

■ Contract Types:

- Firm Fixed Price (FFP)
- Fixed Price with Economic Price Adjustment (FPEPA)
- Fixed Price Incentive (FPI)
 - Fixed Price Incentive (Firm Target)
 - Fixed Price Incentive (Successive Targets)
- Fixed Price with Award Fee (FPAF)
- Cost Sharing (CS) / Cost (C)
- Cost Plus Incentive Fee (CPIF)
- Cost Plus Award Fee (CPAF)
- Cost Plus Fixed Fee (CPFF)
- Cost Plus Percentage of Cost (CPPC)



Risk Sharing

■ Contract Types:

- **Firm Fixed Price (FFP)**
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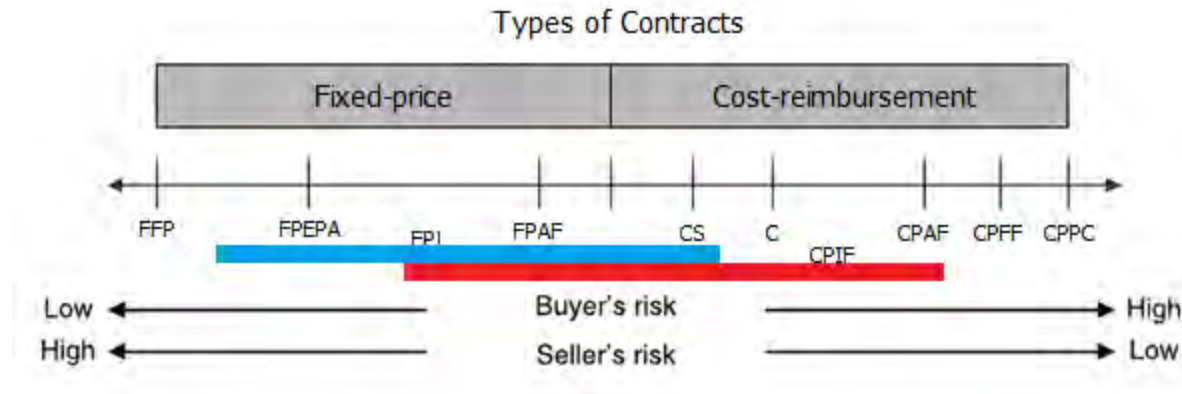


Risk Sharing

Contract Type	Share Line		Equivalent or Direct Equivalent to:
FPIF	0/100	=	Direct Equivalent of FFP
FPIF	100/0	=	Equivalent of CPFF
CPIF	100/0	=	Direct Equivalent of CPFF
CPIF	0/100	=	No logical direct equivalent



Risk Sharing



Proposed scale of cost risk transferred

- **Recommendations:**
 - **Require reporting of share lines and price ceiling percentages**
 - Failing to consider the share line present in an incentive contract risks seriously mischaracterizing implicit contract cost risk
 - **Future research to characterize the difference in risk tradeoffs between FPIF and CPIF**



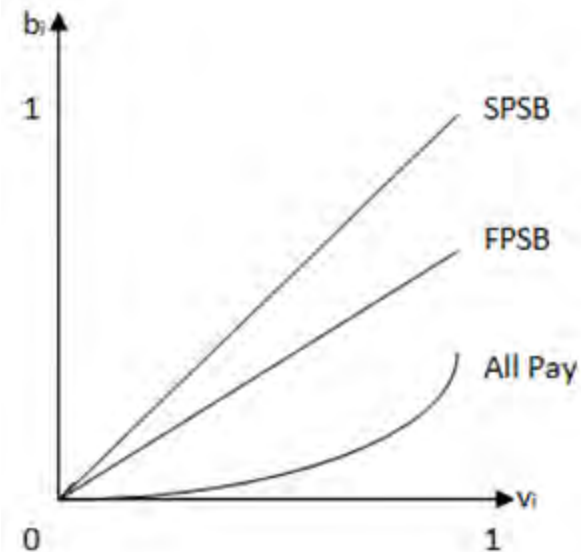
Second Price Sealed Bid

Literature:

Myerson (1981) Revenue Equivalence Theorem

Application: limited to single item, pure price discrimination with multiple bidders

- FFP and FPEPA
- FAR Part 14
- FAR Part 15, LPTA (award without discussions)





Second Price Sealed Bid

Recommendations:

- Utilize Second Price Sealed Bidding for all FAR Part 14 acquisitions
- Utilize Second Price Sealed Bidding for FAR Part 15 LPTA acquisitions that the government is highly confident can be awarded without discussions



Second Score Sealed Bid

Literature:

Che (1993)

- optimal scoring rule auction under one-dimensional quality

Asker and Cantillon (2008)

- Scoring rule dominates menu option and beauty contest in procurement auctions

Bichler (2000)

- Second-price, multi-attribute auctions yield more efficient results than first-price multi-attribute auctions

Nishimura (2012)

- Optimal scoring rule exists with multi-dimensional quality
- Incremental production cost relationship of attributes



Second Score Sealed Bid

Application: differentiated products/services

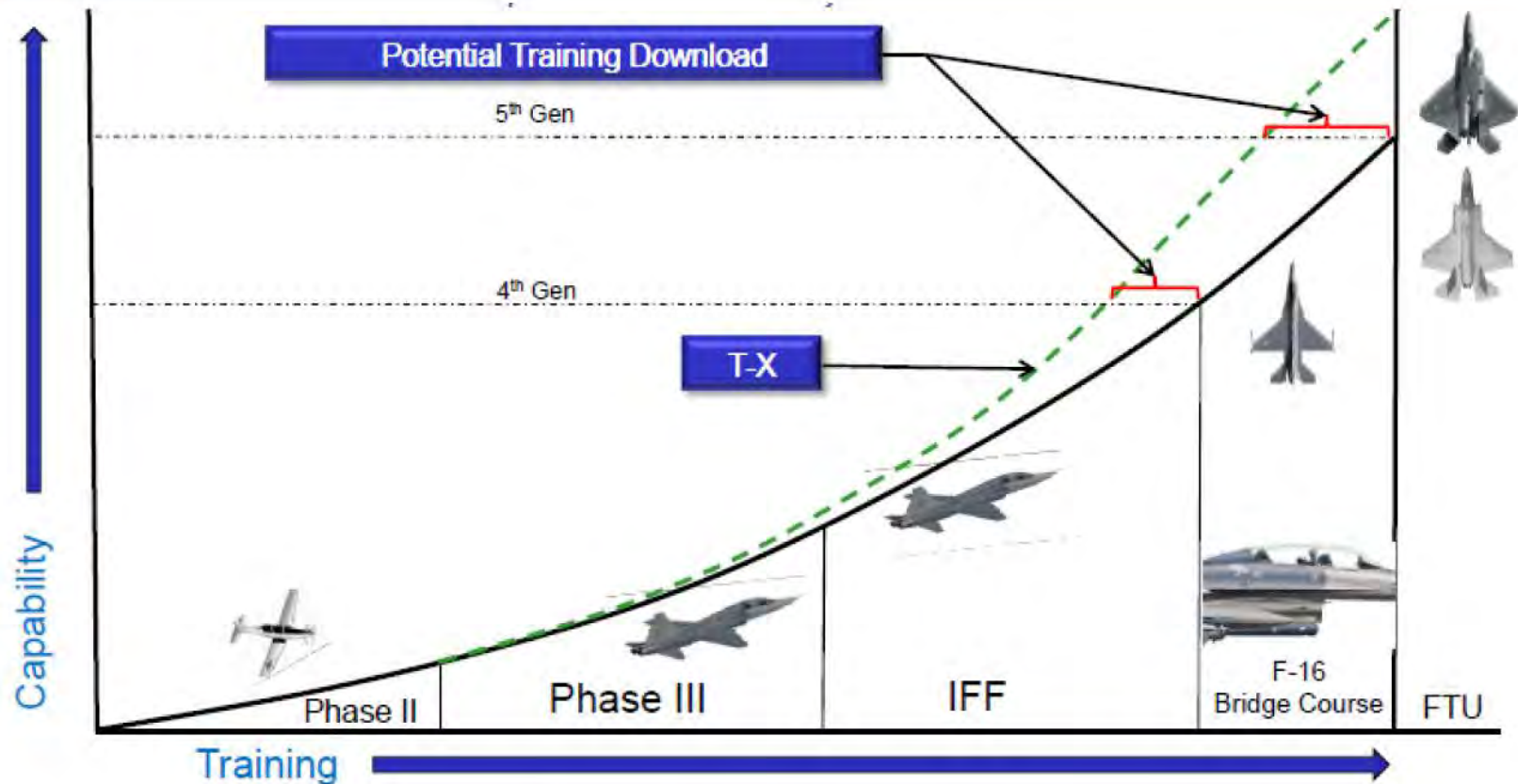
- FAR Part 15 acquisitions
- Requires a publishable scoring rule
- First score bidder graded to the price and score of the second bidder

Recommendations:

- Extends the efficiencies found in Second Price Sealed Bid to differentiated contracts
- Pilot implementation with a program with well-defined requirements
- A possible pilot implementation...



T-X Advanced Pilot Trainer



(T-X Industry Day 29-31 Jan 2013)



T-X Advanced Pilot Trainer

■ Recommendation:

■ Multi-Attribute Second Score Sealed Bid

- Give suppliers freedom to specialize in areas of expertise
- Greater quality incentivized than price only auction

(Bichler 2000)





T-X Advanced Pilot Trainer

■ Recommendation:

- Account for Complimentary and Substitutionary Attributes
 - e.g. Speed vs. Maneuverability
 - Incentivize suppliers to provide quality in multiple areas
 - Focus on complete plane rather than specific attributes
 - Stop suppliers from “gaming” the scoring equation

(Nishimura 2012)





T-X Case Study

Recommendations:

- Utilize Second Score Sealed “Bidding”
- FAR Part 15, FFP with the intent to award without discussions
- Publish model with trade space explicit, to include substitutionary and complementary aspects defined



Reputation Attribute

Literature:

■ Kuwobara

- Reputation Systems
- Opportunity to rate vendor
- Signals: Internet and Rating

■ Fernandes

- Trust Management Systems
- Providing rewards is an effective way to get feedback
- Ebay, Amazon





Reputation Attribute

■ Reputation Attribute

■ Non-Monetary Incentive

- Incentivize “truthful bids” and “sticking to contract”
- Implemented in Bidding / Scoring Process

■ Provide Continuous Reward or Punishment

- Cost, Schedule, Performance
- Reduce Standard Deviations from Original Contract

■ Alternative to CPARS



Reputation Attribute

Assumptions/Criteria

■ Effective If:

- Disclosed Score Individually (secretly)
- Multiple Bids
- Later programs likely to incorporate this in future proposal grading



Summary

The DOD should:

- **Collect share line data to complement continuing research into FPIF and CPIF**
- **Conduct further research distinguishing FFP, FPIF, CPIF, and CPFF**
- **Immediately adopt Second Price Sealed Bid for undifferentiated goods likely to receive multiple offers and award without discussions**
- **Pilot the use of Second Score Sealed Bid**
- **Investigate the use of a separate Reputation Attribute to correct CPARS deficiencies**



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